

## PATENT ABSTRACTS OF JAPAN

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### (54) PICTURE ENCODING DEVICE

(57)Abstract:

PURPOSE: To reduce the required capacity of a Huffman table to miniaturize a memory and to reduce a circuit scale by detecting the coincident codes of pixel data mutually between input and delay picture data and performing an adaptive run length processing. CONSTITUTION: At the point of time of supplying picture data P2 by the portion of a next line of the picture data P1 a coincidence detection circuit 7 detects the coincidence/non-coincidence of the codes of the pixel data of the P2 and the delay data PD1 corresponding to the P1 from a delay circuit 1 and supplies the coincident codes to a run length counter 6. Then a coincident code run length is calculated either the coincident code run length or the run length of the identical codes of the picture elements of input pictures P calculated at the time of not outputting coincidence data is adaptively switched to supplied to a Huffman encoding part 4 as the run length RL and encoded by using the Huffman table 5 and code data CD are outputted. The required capacity of the Huffman table 5 at the time becomes  $(\text{color number} + 1) \times \text{RL}$  and the memory for storage can be miniaturized.

### CLAIMS

[Claim(s)]

[Claim 1] An image encoding apparatus comprising:

A delay means which defined beforehand inputted image data which comprises two or more coded picture element data and which carries out time delay and outputs delay image data.

A coincidence detection means which detects said input and coincidence of numerals of said picture element data between delay image data and is outputted as coincidence

numerals.

Either of the inputted image run lengths which are the continuation length of identical codes of said picture element data of said inputted image computed at the time of a non output of a coincidence numerals run length which is the continuation length of these coincidence numerals computed at the time of said coincidence numerals output and said coincidence numerals accommodative a change \*\*\*\*\* run length. An adaptation run length processing means to output.

A Huffman encoding means which carries out Huffman encoding of said adaptation run length.

[Claim 2] Compare a number of each of said picture element data in which said adaptation run length processing means carried out the output start in a decision point set beforehand and said number of said coincidence numerals and said identical codes uses previous one as valid data. The image encoding apparatus according to claim 1 calculating and generating said adaptation run length.

[Claim 3] The image encoding apparatus according to claim 1 said adaptation run length processing means' comparing said each continuation length in a decision point set beforehand and said continuation length of said coincidence numerals and said identical codes calculating the longer one as valid data and generating said adaptation run length.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the image encoding apparatus which compresses image data efficiently and is coded about an image encoding apparatus.

[0002]

[Description of the Prior Art] In the video computer reduction of circuit structure is desired also in the hardware for a game image display for the cost cut. Therefore in order to perform a variety of display images by small memory space the image data compression by efficient coding of Huffman encoding etc. is used widely and it is \*\*\*\*\* . The above-mentioned Huffman encoding is a kind of the run length coding which average code length is decreased and is coded by assigning code length different as everyone knows according to the frequency of occurrence of the run length which is the continuation length of the same value of the coding data of the pixel of the HARASHIN item.

[0003] As an image encoding apparatus which performs this kind of image data compression conventionally For example the signal in image compression technology inputted into the next from the signal which is already decoded and is already known is predicted the television academic-circles magazine explaining the prediction-coding algorithm which is going to save the amount of information which coding takes by sending the signal for prediction to have separated Vol.43 No. 9-1989 years and the 949- there is a prediction-coding circuit by the difference circuit of a page [ 956th ] statement. This conventional image encoding apparatus computes difference with the delay image data which carried out 1 horizontal-scanning-period (following one line) delay of the

inputted image data which comprises two or more coded picture element data and this inputted image data. The 2nd method of carrying out change \*\*\*\*\* of the 1st method of calculating the difference data run length which is the continuation length of the same value of this difference data or the above-mentioned difference data run length and the inputted image run length that is the continuation length of the same value of the above-mentioned inputted image data accommodative was used.

[0004] When drawing 2 in which the conventional image encoding apparatus by the 1st method is shown is referred to this image encoding apparatus. The delay circuit 1 which time delay of the image data P of an input is carried out for one line and outputs delay image data PD. The difference circuit 2 which computes the difference of image data P and delay image data PD and outputs difference data DD. The run length counter 3 which calculates the continuation length of the same difference value of difference data DD and asks for the run length RL. It has the coding part 4 which carries out Huffman encoding of the run length RL using the Huffman table 5 and the Huffman table 5 which is provided in a memory (not shown) and comprises the table of the output codes corresponding to the run length RL for Huffman encoding.

[0005] Explanation of operation will supply inputted-image-data P to the delay circuit 1 and a difference circuit first respectively. Supply of image data P is answered and the delay circuit 1 supplies delay image data PD delayed by one line to the difference circuit 2. The difference circuit 2 supplies difference data DD which computed the difference value which is a difference between pixel-data-corresponding values of these image data P and PD to the run length counter 3. The above-mentioned difference value calculates the continuing number (merit) of the same difference value and supplies the run length counter 3 to Huffman encoding part 4 in quest of the run length RL. Huffman encoding part 4 codes the supplied run length RL using the Huffman table 5 and outputs code data CD.

[0006] The necessary capacity of the Huffman table 5 serves as a value of the  $x$  (color number  $x \times 2 - 1$ ) run length RL. For example in the case of the image data coded in color palette code of 16 color each pixel of image data is expressed with a 4-bit color code i.e. '0000' to '1111'. If this color code is supplied as image data P the value of the range of -15 to 15 can be taken as a difference value. Therefore the necessary capacity of the Huffman table 5 serves as a value of the  $x$  ( $16 \times 2 - 1$ ) run length RL.

[0007] When drawing 3 in which the conventional image encoding apparatus by the 2nd method is shown is referred to this image encoding apparatus. It adds to the 1st the same delay circuit 1 as a method difference circuit 2 coding part 4 and Huffman table 5. It has the adaptive run length counter 6 which calculates either of the same difference value of difference data DD and the same value of image data P accommodative instead of the run length counter 3 and outputs either of the run length RL of difference data DD and the run length RLP of image data P.

[0008] If operation is explained the operation to the delay circuit 1 and the difference circuit 2 is the same as that of the 1st above-mentioned method. Next in addition to difference data DD image data P is also supplied to the run length counter 6 either the run length RL of difference data DD or the run length RLP of image data P is called for accommodative and it is supplied to Huffman encoding part 4. The run length RL or RLP is coded using the Huffman table 5 like the 1st method below and code data CD is outputted. The necessary capacity of the Huffman table 5 on the same conditions as the

1st method becomes the value of the  $\{(color\ number\ x2-1) + color\ number\} \times run\ length\ RL$  i.e. the value of the  $\{(16x2-1) + 16\} \times run\ length\ RL$ .

[0009]

[Problem(s) to be Solved by the Invention]The necessary capacity of the Huffman table became a double x run length value of the color number mostly and the conventional image encoding apparatus mentioned above had the fault that the capacity of the memory which stores this Huffman table was large therefore circuit structure became large.

[0010]

[Means for Solving the Problem]An image encoding apparatus of this invention comprises:

A delay means which defined beforehand inputted image data which comprises two or more coded picture element data and which carries out time delay and outputs delay image data.

A coincidence detection means which detects said input and coincidence of numerals of said picture element data between delay image data and is outputted as coincidence numerals.

Either of the inputted image run lengths which are the continuation length of identical codes of said picture element data of said inputted image computed at the time of a non output of a coincidence numerals run length which is the continuation length of these coincidence numerals computed at the time of said coincidence numerals output and said coincidence numerals accommodative a change \*\*\*\*\* run length. An adaptation run length processing means to output.

A Huffman encoding means which carries out Huffman encoding of said adaptation run length.

[0011]

[Example]When drawing 1 in which one example of the image encoding apparatus of this invention is shown with a block is referred to the image encoding apparatus of this example The same delay circuit 1 as usual the run length counter 6 and the coding part 4 It has the coincidence detecting circuit 7 which detects coincidence of the coded picture-element-data value which resembles the Huffman table 5 in addition receives supply with picture DE delay picture-data PD instead of the difference circuit 2 and constitutes these image data P and DP and outputs the coincidence numerals S.

[0012]Next operation of this example is explained.

[0013]The picture element data coded in color palette code of 16 colors in image data P is comprised like a conventional example and each picture element data is expressed with a 4-bit color code i.e. '0000' to '1111'. The number of picture element data for one line of image data P is set to 16.

[0014]First the image data P1 for the first one line sets to '2123233213344132' and the image data P2 for following one line sets to '212323333344444'. These image data P1 and P2 are supplied to a phase then the delay circuit 1 the coincidence detecting circuit 7 and the run length counter 6. As the coincidence detecting circuit 7 detects the coincidence disagreement of the numerals for every picture element data of delay image data PD1 of the image data P1 correspondence from the delay circuit 1 and the image data P2 and shows it in Table 1 at the supply time of the image data P2 The numerals coincident part of these image data PD1 and P2 is outputted as the coincidence numerals

and the run length counter 6 is supplied. This coincidence detecting circuit 7 is constituted by 4 input AND gate which performs the AND operation of the output of these image data P2 four EXOR circuits which perform EXCLUSIVE OR operation of each corresponding bit of PD1 and these four EXOR circuits for example.

[0015]

[Table 1]

[0016]

[Table 2]

[0017] As I hear that the processing rule of the adaptive run length counter 6 obtains the longest possible run length RL there is and it is shown in Table 2 When the coincidence numerals S and the numerals of the image data P2 are both the cooperation 1 the numerals output of the direction which changed previously is adopted as valid data all are calculated and the counting result is outputted as the run length RL. However when the run lengths of the numerals are three or less continuation length adopts the longer one as valid data. This 1st rule will be called a point change rule. Here a numerals value change is shown about the image data P2 and change shows change of the existence of the numerals S about the coincidence numerals S respectively. In this example even the 13th pixel is a coincident part from the 10th pixel even with the 7th pixel from the 1st pixel and the coincidence numerals S are outputted. Herein the 6th pixel the numerals value of the image data P2 changes to 3 from 2 and changes to 3-4 in the 12th pixel respectively and by the 7th pixel and the 13th pixel the coincidence numerals S are lost by the following pixel [ 8th ] and the 14th pixel respectively and it changes so that the coincidence numerals S may appear in the 10th pixel. As a result the 10 or 11th pixel becomes the 6 or 7th pixel the same as the coincidence numerals S (=3) and the numerals value 3 of the image data P2 and the coincidence numerals S (=4) and the numerals value 4 of the image data P2 become the same by the 12 or 13th pixel. Since the numerals of a direction which changed previously are adopted as valid data the counting result of the coincidence numerals S currently continued from the 1st pixel about the 6 or 7th pixel About the 10 or 11th pixel the counting result of the numerals value 3 of the image data P2 which already exists from the 8th pixel is outputted as the run length RL respectively. If an above-mentioned processing rule is followed about the 12 or 13th pixel it will become the coincidence numerals S but since there are only 2 run lengths these coincidence numerals S adopt the numerals value 4 of the image data P2 of the longer one and output that counting result as the run length RL. Therefore the run length counter 6 outputs the counting result of 'SSSSSS33334444' as the run length RL and supplies it to Huffman encoding part 4. It codes using the Huffman table 5 and Huffman encoding part 4 outputs code data CD.

[0018] The processing rule of the run length counter 6 is considered not only in the 1st above-mentioned point change rule but variously. Some of these examples are explained below.

[0019] First as the 2nd rule when the coincidence numerals S and the numerals of the image data P2 have both become covariant the length priority rule which compares the

continuation length of each numerals and adopts the numerals of the longer one i.e. the one where a run length is longer as valid data is raised. Priority is given to the numerals of the image data P2 when the continuation length of these coincidence numerals S and the numerals of the image data P2 is equal (each following rule is also the same). In this case supposing image data P is the same as that of the 1st above-mentioned rule shown in Table 1 the run length RL will serve as a counting result of 'SSSSSS33334444' and will become the same as that of the case of the 1st rule.

[0020] Next when the coincidence numerals S and the numerals of the image data P2 have both become covariant like the 1st and 2nd rules as the 3rd rule Compare each numerals continuation length of the following coincidence numerals S after the pixel and the numerals of the picture element data P2 under present input about the following pixel which is a pixel from which one numerals changed as the 1st decision point and when the numerals of the picture element data P2 are longer the numerals of the picture element data P2 are calculated from the part of the above-mentioned change pixel Each numerals continuation length of the next picture element data P2 after the pixel and the present coincidence numerals S is compared about the following pixel which is a pixel from which the coincidence numerals S changed as the 2nd decision point and the longer one is adopted as valid data. Supposing image data P is the same as that of the 1st above-mentioned rule shown in Table 1 as shown in Table 3 the 1st decision point is the 7th pixel of the pixel [ from which the numerals of the image data P2 changed to 3 from 2 / 6th ] next.

Since 6 from the 6th pixel to the 11th pixel one side and the continuation length of the coincidence numerals S after the 8th pixel of the pixel [ 7th ] next are 0 the continuation length of the numerals value 3 of the image data P2 adopts the numerals value 3 of the image data P2 as valid data of the run length RL about this 6 or 7th pixel.

The 2nd decision point is the 11th pixel of the pixel [ in which the coincidence numerals S appeared again / 10th ] next.

Since former one is long when the continuation length 5 of the numerals value 4 of the image data P2 after the following pixel [ 12th ] is compared with the continuation length 4 of the present coincidence numerals S in the 10th pixel - the 13th pixel of overlap portions 3 and 4 of the numerals value of the image data P2 are adopted as valid data of the run length RL.

As a result the run length RL serves as a counting result of 'SSSS3333334444'.

[0021]

[Table 3]

[0022] Next there is a mixed method of the 2nd and the 3rd rule as the 4th rule. That is first the length priority judging of the 2nd rule is performed in the 1st decision point in the 3rd rule and when the continuation length of the coincidence numerals S is longer the coincidence numerals S are adopted as valid data of the run length RL. If the direction of the continuation length of the numerals value of the image data P2 excels processing by the 3rd rule will be performed.

[0023] On condition of the same image data as the 3rd rule by the 7th pixel of the 1st decision point since the continuation length of the coincidence numerals S is longer the coincidence numerals S are adopted as valid data of the run length RL as the pixel [ 6 or

7th ] numerals. About a subsequent pixel the numerals value 4 of the image data P2 is adopted for the numerals value 3 of the image data P2 as valid data of the run length RL by the 12 or 13th pixel by the 10 or 11th pixel according to the 2nd rule respectively. As a result the run length RL serves as a counting result of 'SSSSSS33334444' and becomes the same as that of the case of the 1st and 2nd rule.

[0024] Next modification of the mixed method of the 2nd and the 3rd rule occurs as the 5th rule. First a shortness priority judging contrary to the 2nd rule is performed in the 1st decision point in the 3rd rule and when the continuation length of the coincidence numerals S is shorter the coincidence numerals S are adopted as valid data of the run length RL. If the continuation length of the numerals value of the image data P2 is shorter processing by the 3rd rule will be performed.

[0025] In this example in the 7th pixel of the 1st decision point in the 3rd rule since the continuation length of the numerals value of the image data P2 is shorter The 6 or 7th pixel and each pixel [ 10 or 11th ] numerals adopt the numerals value 4 of the image data P2 for the numerals value 3 of the image data P2 as valid data of the run length RL by the 12 or 13th pixel again according to the 3rd rule respectively. As a result the run length RL serves as a counting result of 'SSSSS3333334444' like the 3rd rule.

[0026] Next as the 6th rule when [ of the coincidence numerals S and the numerals of the image data P2 ] having both become covariant the overlap portions of numerals value change are distributed to both as valid data of the run length RL by halves.

[0027] The coincidence numerals S are distributed in this example and in the 6th pixel the 7th pixel distributes the numerals value 3 of the image data P2 in the pixel [ 6 or 7th ] overlap portions respectively. About the 10 or 11th pixel and the 12 or 13th pixel the former is distributed to the numerals value 3 of the image data P2 and the latter is distributed to the numerals value 4 of the image data P2 so that the output run length RL can be lengthened rather than distributing half-and-half respectively. As a result the run length RL serves as a counting result of 'SSSSSS3333334444'.

[0028] Next as the 7th rule when [ of the coincidence numerals S and the numerals of the image data P2 ] having both become covariant the overlap portions of numerals value change are divided so that each run length may become equal and it distributes to both as valid data of the run length RL (grade run length rule). Priority is given to the image data P2 when it cannot divide equally.

[0029] In this example in the pixel [ 6 or 7th ] overlap portions if this 6 or 7th pixel is distributed to the numerals value 3 of the image data P2 the run length of this numerals value 3 will be set to 6 and the run length of the coincidence numerals S will be set to 5. On the other hand if the 6th pixel is distributed to the coincidence numerals S as for the run length of the numerals value 3 the run length of 5 and the coincidence numerals S will be set to 6. Therefore in neither of the cases both run length becomes equivalent. As mentioned above since priority is given to the image data P2 in such a case the 6 or 7th pixel is distributed to the numerals value 3 of the image data P2. Others are processed like the 1st - the 5th rule. As a result the run length RL serves as a counting result of 'SSSSSS3333334444' like the 3rd and 5th rules.

[0030] The necessary capacity of the Huffman table 5 serves as a value of the  $x$  (color number + 1) run length RL. For example in the case of the image data coded in color palette code of 16 colors the necessary capacity of the Huffman table 5 becomes with the value of the  $x$   $(16+1)$  run length RL. This corresponds [ two ] in about  $1/\text{of the } x$   $(16 \times 2 - 1)$

run length RL of an above-mentioned conventional example is  $\{(16 \times 2 - 1) + 16\} \times \text{run length RL}$ .

[0031] Although this example explained the case where it applied to the line correlation which used 1 line delay, it may apply to the frame correlation using 1 frame delay.

[0032]

[Effect of the Invention] As explained above, the image encoding apparatus of this invention. The coincidence detection means which outputs an input and the coincidence numerals of the picture element data between delay image data. By having an adaptation run length processing means which carries out change \*\*\*\*\* of either of the coincidence numerals, run length computed at the time of the above-mentioned coincidence numerals output and the run length of the identical codes of the pixel of the inputted image computed at the time of the non output of the above-mentioned coincidence data accommodative. Since the necessary capacity of the Huffman table can be managed with or less conventional about  $1/2$  the memory for this Huffman table storing can be miniaturized, therefore it is effective in circuit structure being reducible.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is a block diagram showing one example of the image encoding apparatus of this invention.

[Drawing 2] It is a block diagram showing the first example of the conventional image encoding apparatus.

[Drawing 3] It is a block diagram showing the second example of the conventional image encoding apparatus.

[Description of Notations]

- 1 Delay circuit
  - 2 Difference circuit
  - 3 and 6 Run length counter
  - 4 Coding part
  - 5 Huffman table
  - 7 Coincidence detecting circuit
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